DOCUMENT RESUME

ED 311 247 CE 053 253

AUTHOR	Duchin, Faye; Lange, Glenn-Marie
TITLE	Trading Away Jobs: The Effects of the US Merchandise Trade Deficit on Employment. Working Paper No. 102.
INSTITUTION	Economic Policy Inst., Washington, DC.
PUB DATE	Oct 88
NOTE	39p.
AVAILABLE FROM	Economic Policy Institute, 1730 Rhode Island Avenue, NW, Suite 812, Washington, DC 20036 ($4.00).
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Dislocated Workers; Employment; *Employment Opportunities; Exports; Imports; *International Trade; *Labor Force; Labor Market; *Manufacturing Industry; Mathematical Models; Occupational Surveys; *Service Occupations; Wages

ABSTRACT

A study was conducted to describe the segments of the U.S. labor force that have been affected by the recent deterioration in U.S. trade. The methodology involved computer modeling of the effects of eliminating the 1987 merchandise trade deficit on employment by detailed industry and occupation, by geographic region, and by wage group. This was done by calculating the number of jobs of different characteristics and in different industries that are required for the production of merchandise exports and those that would be required for the domestic production of imports. All computations were made with an input-output model of the U.S. economy using the most recent trade data (1987), providing a consistent framework for simultaneously computing the detailed production requirements of every industry. The advantage of this approach was that it allowed the calculation of all production requirements for satisfying a given bill of final deliveries, in this case, imports and exports. Specific findings were as follows: (1) the record trade deficit in 1987 represented a loss of 5.1 million job opportunities, 2 million of which were lost between 1984 and 1987; (2) 60 percent, or 3.1 million of the total 5.1 million jobs lost, were in manufacturing, and the remaining 2 million jobs were lost in industries closely related to manufacturing, primarily in business services; (3) each of the four regions lost over 1 million jobs because of the trade deficit, with the Midwest and the West each losing 1.4 million jobs; and (4) the wages of the jobs from trade were more likely to be high-wage jobs. The most important conclusions were that the employment effects of the trade deficit are large and more dispersed in the economy than commonly believed. (A 14-item reference list and two appendices, one on U.S. Merchandise Trade in 1987 and one on methodology and classifications, are attached.) (NLL)

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TRADING AWAY JOBS:

The Effects of the US Merchandise Trade Deficit on Employment

Faye Duchin and Glenn-Marie Lange*

Working Paper No. 102
October 1988

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* Faye Duchin is the Director of the Institute for Economic Analysis at New York University. Glenn-Marie Lange is a research economist at the Institute for Economic Analysis.

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TRADING AWAY JOBS:
The Effects of the US Merchandise Trade Deficit on Employment

Introduction

American imports and exports as a share of GNP have grown steadily over the past few decades. However, in the 1980s imports skyrocketed while exports remained relatively stagnant, culminating in a record merchandise trade deficit of $171.2 billion in 1987 despite the declining value of the dollar.

International trade is generally expected to contribute to all partners' economic well-being; governed by comparative advantage, trade is supposed to assure that consumers pay the lowest prices while increasing the variety and quality of products available. The declining international competitiveness of many US manufacturing industries during the 1980s suggests that changes may have taken place in US comparative advantage or that other countries use tariff and non-tariff barriers to compete unfairly with US goods and services. Whatever the reasons, many adjustments of domestic production and employment to changes in US international trade are taking place.

This study describes which segments of the American labor force have been affected by the recent deterioration in US trade. Our most important conclusions are that the employment effects of the trade deficit are large and they are more widely dispersed throughout the economy than is commonly believed.

* The record trade deficit in 1987 represents a loss of 5.1 million job opportunities, two million of which were lost between 1984 and 1987.

* Sixty percent, or 3.1 million, of the total 5.1 million job loss was lost in

manufacturing. The remaining two million jobs were lost in industries closely related to manufacturing, primarily in business services.

* Each of the four regions lost over one million jobs because of the trade deficit, with the Midwest and the West each losing 1.4 million jobs.

* The wages of the jobs lost from trade are less likely to be low wage and are more likely to be high-wage jobs. There were 2.5 million fewer jobs paying more than $400 per week because of the trade deficit in 1987.

Methodology

This paper examines the effects of eliminating the 1987 merchandise trade deficit on employment by detailed industry and occupation, by geographic region, and by wage group. This is done by calculating the number of jobs of different characteristics and in different industries that are required for the production of merchandise exports and those that would be required for the domestic production of imports.

All computations were made with an input-output model of the US economy which provides a consistent framework for simultaneously computing the detailed production requirements of every industry.[1] The unique advantage of this approach is that it allows the calculation of all production requirements for satisfying a given bill of final deliveries, in this case imports and exports. For example, for each bushel of grain exported, it

[1]A model of the world economy in which trade is endogenously determined, based on comparative advantage and government policies, would make it possible to assess changes in the level and composition of trade and the consequent employment effects resulting from various measures aimed at eliminating the trade deficit such as lowered cost structures or barriers to certain imports. There is currently no such operational world model, and the experiment reported here provides a useful first approximation to the number and types of jobs that might be created under certain assumptions about balanced trade.

computes not only the requirements for farm equipment but also the amount of steel absorbed by the agricultural equipment manufacturers as well as even more indirect requirements, such as the iron ore and electrical power necessary to produce the steel and the different categories of labor required in all of these rounds. The model we have used also includes the explicit representation of replacement capital necessary to sustain production and distinguishes total from domestic output and labor requirements by netting out imported intermediate inputs.

A number of other studies have evaluated the effects on employment of a particular year's trade bill using a similar methodology (Office of Technology Assessment, 1988; International Trade Commission, 1986; Stone and Sawhill, 1986; Young, Lawson, and Duncan, 1986).

This study examines the most recent trade data (1987) and for the first time systematically assesses the implications of trade for workers classified by wage groups. An analysis of US merchandise trade in 1987 upon which the discussion of balance trade is based is provided in Appendix A. A detailed description of the methodology and data sources and the sectoral and occupational classification schemes is provided in Appendix B. Tables giving more detail than that provided in the text are in an appendix available upon request.

Implications of a Balanced Trade Scenario

Many prior studies have assessed the trade impact on employment by comparing employment generated by exports with employment, which would have been required if all the goods we imported had instead been produced domestically. Such a computation of "net jobs lost" represents an implicit comparison with an economy completely closed to

trade. A realistic assessment of the effect on employment of the merchandise trade deficit in 1987 requires, rather than a "no-trade" assumption, a comparison of the actual situation with a hypothetical situation of balanced trade.

In order to evaluate the employment effects of the trade deficit within the framework of the one-country input-output model, an assumption about how balanced merchandise trade will be achieved must be specified--which industries will gain more exports and/or face less import competition.[2]

There are many different combinations of exports and imports which could close the 1987 merchandise trade gap of $171.2 billion at any given volume of total trade. The exact number of jobs and their distribution by occupation, industry, and wage group will obviously depend on the particular balanced trade scenario assumption selected. Table 1 presents computations of the effect of trade on total employment using three different assumptions about how balanced trade is achieved. The first case shows that if merchandise exports increased by $171.2 billion to match the level of imports, an additional 5.5 million additional jobs can be generated. The second case is where the value of imports is reduced by $171.2 billion to match that of exports--in which case 4.8 million additional jobs are generated.

[2]Of course, it is not necessary that merchandise trade be exactly in balance so long as the total trade bills are more or less balanced.

TABLE 1

Employment Loss Associated with Trade Deficit Under Alternative Balanced Trade Assumptions

	#1 Export Growth	#2 Import Reduction	#3 Combination
Balanced Trade Assumptions:			
Increase Exports	$171.2	$ 0.0	$ 85.6
Decrease Imports	$ 0.0	$171.2	$ 85.6
Reduction of Merch. Trade Deficit	$171.2	$171.2	$171.2
Employment Impact of Trade Deficit in:			
1987	5.5 million	4.8 million	5.1 million
1984*	3.3 million	3.0 million	3.1 million

* Based on Rousslang and Parks (1986, pp.12-13).

The third case combines the first two; it assumes that merchandise trade is balanced with the total value of exports rising by $85.6 billion, imports falling by the same amount, and the fall in imports replaced by a corresponding amount of domestic production (case #3). The composition of imports and of exports was assumed to remain unchanged as the total levels of merchandise trade adjusted. This third case is used throughout this study to evaluate the employment effects of the trade deficit within the framework of the one-country input-output model.

The results of the "combination" balanced trade assumption reveal that the net loss of employment attributable to the 1987 merchandise trade deficit amounts to 5.1 million jobs; 2.7 million jobs would be generated by increasing exports by $85.6 billion over

current levels and 2.4 million jobs would be created by the same dollar amount of import substitution--the domestic production of some of the goods that were instead imported in 1987.

Comparable estimates from an International Trade Commission study of trade-related employment in 1984 shows that the merchandise trade deficit in that year caused a loss of 3.0 to 3.3 million jobs. The deterioration in trade from 1984 to 1987, therefore, was associated with a loss of two million job opportunities.

The estimate of roughly five million jobs lost as a result of the 1987 trade deficit at first glance might seem large when compared to official total unemployment in 1987 of 7.4 million. But the official number understates the magnitude of excess labor force capacity. There were in 1987 over one million discouraged workers (i.e., workers who would reenter the labor market if they felt they could find work) and roughly 5 million part-time workers who wanted to work full time (Mishel and Simon, 1988, p.19). Moreover, had the trade deficit not deteriorated so much during the 1980s, we would have more industrial capacity today because plant and equipment spending would have been higher and less industrial capacity would have been shut down.

Prior to 1986, one might also have argued that eliminating the merchandise trade balance was an unnecessarily ambitious policy goal, since the merchandise trade deficit has been historically offset by income from investments and services. Now, however, the nation is running a deficit in its foreign investment account as well. Thus, eliminating the overall current account deficit over the next decade will almost certainly require us to run a merchandise trade surplus.

In any event, while there is little possibility of the merchandise trade deficit being

eliminated quickly, the estimates do indicate the potential employment gains from such a reduction over time.

Employment Effects by Sector, Region, Occupation, and Wage Level

Eliminating the trade deficit would create 1.6 million manufacturing export related jobs and create 1.5 million manufacturing jobs due to lower import competition (Table 2). Machinery and other heavy manufacturing and electronics have been disproportionately hurt most by our trade deterioration and stand the most to gain from achieving balanced trade. This 3.1 million total gain in manufacturing, however, represents only 60 percent of the 5.1 million job gain resulting from eliminating the trade deficit even though manufacturing accounts for 83 percent of the 1987 merchandise trade deficit. This is because other industries related to manufacturing, such as business services, are significantly affected by the reduced manufacturing production represented by the trade deficit. Business services, in fact, would gain over one million jobs, one-fifth of the total, by achieving balanced trade.

TABLE 2
Employment Requirements by Sector for the
Elimination of the Merchandise Trade Deficit
(in thousands)

Industry	Jobs Created by Increase in Exports	Jobs Created by Decrease in Imports	Total	Percent of Total	Economy as a Whole
1 Agricultural Products	173.8	100.3	274.0	5.3	2.1%
2 Raw Materials	60.9	63.4	124.3	2.4	0.7
3 Construction	76.7	80.8	157.5	3.1	6.6
4 Light Mfg. I	161.6	331.5	493.1	9.6	3.7
5 Light Mfg. II	160.8	139.7	300.5	5.8	4.4
6 Chemicals and Related Products	119.3	74.9	194.3	3.8	1.2
7 Machinery and Heavy Manufactures	581.3	507.8	1089.1	21.2	4.6
8 Electronics and Telecommunications	472.9	323.8	796.7	15.5	2.4
9 Transportation Equipment	125.3	100.0	225.2	4.4	2.4
10 Business Services	577.5	497.0	1074.5	20.9	39.7
11 Non-business Services	227.0	187.2	414.3	8.1	27.6
Total Mfg.	1619.3	1477.7	3097.0	60.2	18.7
Total	2735.2	2406.4	5141.6	100.0	100.0

Source: Labor requirements for exports and imports were calculated by the model described in Appendix A. Employment measured in person years. The distribution of the labor force for the economy as a whole was obtained from the US Department of Labor, Bureau of Labor Statistics, Employment and Earnings, January 1988.

Note: This computation assumes domestic production of previously imported goods according to the scenario described in the text: exports increase by $85.6 billion, imports decrease by $85.6 billion relative to the actual situation in 1987.

Columns may not sum to total due to rounding.

Regionally, the Midwest is more sensitive to trade than the other sections of the country, and would gain disproportionately from balanced trade (Table 3). The Northeast and South would gain jobs in proportion to their share in the economy, with gains of over one million jobs in each region. Again, we see that the negative impact of our trade deterioration and the possible gains from balanced trade are widespread.

TABLE 3
Employment Requirements by Geographic Region
for the Elimination of the Merchandise Trade Deficit
(in thousands)

Regions	Jobs Created by Increase in Exports	Jobs Created by Decrease in Imports	Total	Percent of Total	Economy as a Whole
Northeast	686.6	601.6	1288.1	25.1%	25.4%
South	536.1	510.2	1046.3	20.4	20.8
Midwest	735.8	647.3	1383.1	26.9	23.7
West	779.5	647.3	1426.9	27.8	30.1
Total	2735.2	2406.4	5141.6	100.0	100.0

Source: Labor requirements for exports and imports were calculated by the model described in Appendix A. Employment measured in person years. The distribution of the labor force for the economy as a whole was obtained from the US Department of Commerce, Bureau of Economic Analysis, "Gross State Product."

Note: This computation assumes domestic production of previously imported goods according to the scenario described in the text: exports increase by $85.6 billion, imports decrease by $85.6 billion relative to the actual situation in 1987.

Columns may not sum to total due to rounding.

In terms of occupations, the largest number of jobs gained would be those for operatives and crafts workers, and, perhaps surprisingly, for clerical workers (Table 4). Nearly 700,000 professional jobs would be created, an amount equal to 13.4 percent of the total gain and comparable to the share of professional workers in the workforce (15 percent).

TABLE 4
Employment Requirements by Occupation for the Elimination of the Merchandise Trade Deficit
(in thousands)

Occupation	Jobs Created by Increase in Exports	Jobs Created by Decrease in Imports	Total	Percent of total	Economy as a Whole
Professionals	392.9	297.1	690.0	13.4%	15.2%
Managers	238.9	205.5	444.3	8.6	11.8
Sales Workers	89.0	77.1	166.1	3.2	12.0
Clerical Workers	420.3	359.6	779.9	15.2	16.2
Crafts Workers	430.6	392.1	822.7	16.0	12.1
Operatives	720.8	742.2	1463.0	28.5	11.3
Service Workers	154.1	127.6	281.7	5.5	13.4
Laborers	129.3	126.7	256.0	5.0	4.3
Farm Workers	161.8	77.9	239.7	4.7	3.1
Total	2735.2	2406.4	5141.6	100.0	100.0

Source: Labor requirements for exports and imports were calculated by the model described in Appendix A. Employment measured in person years. The distribution of the labor force for the economy as a whole was obtained from the US Department of Labor, Bureau of Labor Statistics, Employment and Earnings, January 1988.

Note: This computation assumes domestic production of previously imported goods according to the scenario described in the text: exports increase by $85.6 billion, imports decrease by $85.6 billion relative to the actual situation in 1987.

Columns may not sum to total due to rounding.

Table 5 shows the wage levels of the jobs in export and import related industries that would be gained by achieving balanced trade. The jobs gained through greater exports are somewhat less likely to be, relative to the economy, low-wage (weekly earnings under $300) jobs and are more likely to be high-wage jobs (paying more than $599 weekly). Jobs gained by reduced import competition have similar wage levels to jobs in the economy as a whole, although characterized by slightly more high-wage and slightly fewer medium-wage jobs.

TABLE 5
Employment Requirements by Wage Group for the Elimination of the Merchandise Trade Deficit
(in thousands)

Occupation	Jobs Created by Increase in Exports	Jobs Created by Decrease in Imports	Total	Percent of Total	Economy as a Whole
under $199	291.9	286.8	578.7	11.3%	12.0%
$200-$299	594.1	547.0	1141.2	22.2	22.3
$300-$399	508.5	444.3	952.8	18.5	18.6
$400-$499	426.3	363.0	789.3	4 15.4	15.4
$500-$599	305.6	260.3	565.9	11.0	11.1
$600-$749	262.8	221.7	484.5	9.4	9.5
$750-$998	192.6	158.4	351.0	6.8	6.4
$999 and over	154.1	125.8	279.9	5.5	4.7
Total	2735.2	2406.4	5141.6	100.0	100.0

Source: Labor requirements for exports and imports were calculated by the model described in Appendix A. Employment measuredd in person years. The distribution of the labor force for the economy as a whole was obtained from the US Department of Labor, Bureau of Labor Statistics, "Table A-20. Usual Weekly Earnings of Employed Wage and Salary Workers Who Usually Work Full-Time."

Note: This computation assumes domestic production of previously imported goods according to the scenario described in the text: exports increase by $85.6 billion, imports decrease by $85.6 billion relative to the actual situation in 1987.

Columns may not sum to total due to rounding.

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Appendix A. US Merchandise Trade in 1987

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US Merchandise Trade in 1987

Merchandise Trade and Corresponding Output Requirements

Considerable differences in both volume and structure of US merchandise imports and exports for 1987 are revealed in Tables A1 and A2. Within this classification scheme, US net trade is negative in all but two sectors, agriculture and chemicals, and amounts to a total deficit of $171 billion. Both exports and imports of merchandise are dominated by "heavy" manufacturing including machinery, electronics, and transportation equipment, which together account for nearly 62 percent of the value of merchandise exports and 58 percent of imports. The US also imports a large dollar amount of raw materials, primarily petroleum, and exports a large amount of agricultural products and chemicals. Light manufacturing has been split into two categories, those sectors with low to medium average wages for production workers (Light Manufacturing I) such as textiles and apparel, lumber and leather products, and those sectors with medium to high average wages (Light Manufacturing II) such as food, paper products, printing and publishing, glass, stone, and clay products. The US exports about twice the dollar volume of commodities produced by the latter as the former while imports of light manufactured goods are in nearly opposite proportions.

TABLE A1
US Merchandise Exports and Imports in 1987
(millions of 1987 dollars)

Industry	Exports	Imports	Net Trade
1 Agricultural Products	$18985.	$16033.	$2952.
2 Raw Materials	5613.	37081.	-31468.
3 Construction	0.	0.	0.
4 Light Mfg. I	13281.	58887.	-45606.
5 Light Mfg. II	25737.	33621.	-7884.
6 Chemicals and Related Products	32717.	30916.	1801.
7 Machinery and Heavy Manufactures	72324.	103062.	-30738.
8 Electronics and Telecommunications	39490.	56057.	-16567.
9 Transportation Equipment	44719.	88426.	-43707.
Total Mfg.	228268.	370968.	-142700.
Total	252866.	424082.	-171216.

Source: US Department of Commerce, 1988

Note: Sum of entries may not equal totals due to rounding.

The sectoral composition of merchandise imports and exports is even more dissimilar when industries are disaggregated to the 85 sector level at which computations were actually carried out (not shown). For example, transportation equipment represents an important share of the value of both exports and imports, but motor vehicles are the largest import category while aircraft are among the most important exports.

TABLE A2
Sectoral Distribution of US Merchandise Exports and Imports in 1987

Industry	Exports	Imports
1 Agricultural Products	7.5%	3.8%
2 Raw Materials	2.2	8.7
3 Construction	0.0	0.0
4 Light Mfg. I	5.3	13.9
5 Light Mfg. II	10.2	7.9
6 Chemicals and Related Products	12.9	7.3
7 Machinery and Heavy Manufactures	28.6	24.3
8 Electronics and Telecommunications	15.6	13.2
9 Transportation Equipment	17.7	20.9
Total Mfg.	90.3	87.5
Total	100.0	100.0

The relative importance of different sectors in the import and export bills of goods comprises only the tips of two icebergs in terms of the economic requirements of trade. Many other goods and services need to be produced as inputs to these bills of goods. Table A3 compares the relative importance of imports and exports by sector with the relative importance of each sector's total contributions to the trade bills of goods. The two icebergs are more similar below the water line than above: the numbers in the second column of Table 3 are generally closer to 1.0 than the corresponding numbers on the first column.

TABLE A3
The Relative Contribution of Different Sectors in Satisfying, Directly and Indirectly, the Merchandise Export and Import Bills of Goods

Industry	Direct Output Required for Production Imports/Exports	Total Output Required for Production Imports/Exports
1 Agricultural Products	0.84	0.98
2 Raw Materials	6.61	2.41
3 Construction	N/A	1.77
4 Light Mfg. I	4.43	2.93
5 Light Mfg. II	1.31	1.37
6 Chemicals and Related Products	0.94	1.17
7 Machinery and Heavy Manufactures	1.43	1.50
8 Electronics and Telecommunications	1.42	1.30
9 Transportation Equipment	1.98	1.79
10 Business Services	N/A	1.46
11 Non-business Services	N/A	1.40
Total	1.68	1.54

Note: Column 1, the ratio of imports to exports of a given sector, represents the relative direct output requirements of that sector. Column 2 represents the total output required, directly and indirectly, in the domestic production of imports relative to the entire bill of exports. For example, chemical imports are only 94%, by value, of chemical exports. But if the entire bill of imports were produced domestically, more chemical production (1.17%) would be required as for the delivery of the entire export bill of goods.

Labor Requirements

The amount of employment required to produce the merchandise entering into international trade depends on both the volume and the composition of US trade. Not surprisingly, given the large trade deficit, the total employment generated by 1987 exports (see Table A4) is considerably smaller than the employment necessary for the domestic production of imports. However, Table A5 shows that the composition of US exports emphasizes the labor intensive sectors--31.95 workers are required to produce a million dollars of merchandise exports compared to 28.11 workers per million dollars of imports. [See also Leontief, 1953 and Leontief and Duchin, 1985 which establish a similar result for other years.]

TABLE A4
Total Labor Requirements by Occupation for the
Domestic Production of Traded Merchandise in 1987*

Occupation	Exports	Percent of Total	Imports	Percent of Total	Economy as a Whole	Percent of Total
Professionals	1150.4	14.2%	1472.7	12.4%	17772.0	15.8%
Managers	704.2	8.7	1017.3	8.5	13316.0	11.8
Sales Workers	262.7	3.3	382.0	3.2	13480.0	12.0
Clerical Workers	1242.6	15.4	1779.6	14.9	18256.0	16.2
Crafts Workers	1272.2	15.7	1943.8	16.3	13568.0	12.1
Operatives	2130.1	26.4	3677.2	30.8	12707.0	11.3
Service Workers	454.8	5.6	632.6	5.3	15054.0	13.4
Laborers	383.0	4.7	629.3	5.3	4779.0	4.3
Farm Workers	478.1	5.9	385.1	3.2	3507.0	3.1
Total	8078.1	100.0	11919.7	100.0	112440.0	100.0

* Measured in person years.

Source: Labor requirements for exports and imports were calculated by the model described in Appendix A. The distribution of the labor force for the economy as a whole was obtained from the US Department of Labor, Bureau of Labor Statistics, Employment and Earnings, January 1988.

Exports and imports also differ in the relative intensity of use of various occupational groups. Imported merchandise requires more operatives per million dollars of deliveries than exported merchandise, roughly the same proportion of laborers, and fewer of all other occupations, notably farm and professional workers. The overwhelming importance of operative and craft labor for both exports and imports, compared to the economy as a whole, is explained by the predominance of manufactured goods in merchandise trade. Tables A4 and A5 show that the production of exports and imports also makes significant demands on two non-production categories, clerical workers--attributable primarily to large indirect production requirements especially of business services--and professionals, whose employment is dispersed across many industries.

TABLE A5
Employment Requirements by Occupation for the Domestic Production of One Million Dollars of Merchandise Exports and Imports in 1987*

Occupation	Exports	Imports
Professionals	4.59	3.47
Managers	2.79	2.40
Sales Workers	1.04	0.90
Clerical Workers	4.91	4.20
Crafts Workers	5.03	4.58
Operatives	8.42	8.67
Service Workers	1.80	1.49
Laborers	1.51	1.48
Farm Workers	1.89	0.91
Total	31.95	28.11

* Measured in person years.

The sectoral distribution of employment is shown in Table A6. Roughly 29 percent of the total labor required for the production of exports and of imports results from indirect production requirements in the two broadly defined service sectors. Despite the occupational and sectoral differences in employment requirements for exports and imports they are more similar to each other than to the employment requirements for the economy as a whole where, for example, service sectors account for 57 percent of all employment. A detailed table of employment by occupation and industry for exports and imports is given in Appendix C.[3]

[3] Appendix C is available upon request from the Economic Policy Institute.

TABLE A6
Total Labor Requirements by Sector for the Production of Traded Merchandise in 1987*

Industry	Exports Total	Percent of Total	Imports	Percent of Total	Economy as a Whole	Percent of Total
Agriculture	506462	6.3%	496415	4.2%	2366.0	2.1%
Mining	179809	2.2	314039	2.6	818.0	0.7
Construction	226671	2.8	400400	3.4	7456.0	6.6
Light Mfg. I	477423	5.9	1642070	13.8	4139.0	3.7
Light Mfg. II	474962	5.9	691965	5.8	4911.0	4.4
Chemicals and Related Products	352543	4.4	371038	3.1	1391.0	1.2
Machinery/Other Heavy Mfg.	1716994	21.3	2515541	21.1	5178.0	4.6
Electronics	1396849	17.3	1603958	13.5	2673.0	2.4
Transportation Equipment	369938	4.6	495423	4.2	2642.0	2.4
Business Services	1705900	21.1	2461616	20.7	44583.0	39.7
Non-business Services	670503	8.3	927262	7.8	31037.0	27.6
Total Mfg.	4798364	59.4	7342552	61.6	21026.3	18.7
Total	8078054	100.0	11919727	100.0	112440.0	100.0

* Measured in person years.

Source: Labor requirements for exports and imports were calculated by the model described in Appendix A. The distribution of the labor force for the economy as a whole was obtained from the US Department of Labor, Bureau of Labor Statistics, Employment and Earnings, January 1988.

The regional shares of employment generated by the production of merchandise exports, shown in Table A7, are generally similar to the shares generated by the domestic production of merchandise imports and both are similar to the composition of the entire labor force. No single region stands out as disproportionately vulnerable to trade problems.

TABLE A7
Shares of Employment by Geographic Region Required for the Domestic Production of Merchandise Exports and Imports in 1987

Region	Exports	Imports	Economy
Northeast	25.1%	25.0%	25.4%
South	19.6	21.2	20.8
Midwest	26.9	26.9	23.7
West	28.5	26.9	30.1
Total	100.0	100.0	100.0

Source: US Department of Commerce, Bureau of Economic Analysis. Gross State Product by Industry, 1988 and US Department of Labor, Bureau of Labor Statistics, Employment and Earnings, January 1988

The occupational composition of employment generated by exports and by imports is very similar across regions, except for the employment of farm workers. The employment required for the domestic production of exports is dominated in each region by three sectors, business services, electronic products and machinery, which account for 66 percent of such employment in the Northeast, 51 percent in the South, 61 percent in the Midwest, and 50 percent in the West. Sectoral distribution of the remaining labor force varies, with low-wage light manufacturing employing a disproportionately large number of workers in the South and machinery and transportation equipment more important in the Midwest.

The business services, electronic products, and machinery sectors are relatively less important for the domestic production of merchandise imports, although still accounting for

most of the employment requirements. In addition, the domestic production of imported merchandise would place particularly high demands on low-wage light manufacturing in the Northeast, the South and the Midwest; mining (mainly petroleum) in the West; and transportation equipment in the Midwest.

Employment by Wage Group

From an economic and a policy point of view, it is important to identify not only the number of jobs but the wages associated with merchandise trade as a basis for assessing the effect of the trade deficit on workers. A matrix of employment requirements by wage group and by industry was constructed using data from the Bureau of Labor Statistics (1988) based on weekly earnings reported in the 1987 Current Population Survey. (More detail is provided in the Appendix C). This matrix was used to calculate the labor content by wage group for merchandise exports and for the domestic production of imports.[4] It has already been established that the production of one million dollars of exports requires more labor than one million dollars of imports, and Table A8 shows that this is true in all wage groupings.

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[4]The same calculations reported below were made using industry average wages. The two sets of computations produced similar results.

TABLE A8
Employment Requirements for the Production of One Million Dollars of Merchandise Exports and Imports by Wage Group in 1987*

Weekly Earnings	Exports	Imports	Ratio of Labor Required for Exports to Labor Required for Imports
1. Under $199	3.41	3.35	1.018
2. $200 - $299	6.94	6.39	1.086
3. $300 - $399	5.94	5.19	1.145
4. $400 - $499	4.98	4.24	1.175
5. $500 - $599	3.57	3.04	1.174
6. $600 - $749	3.07	2.59	1.185
7. $750 - $998	2.25	1.85	1.216
8. Above $999	1.80	1.47	1.225
Total	31.95	28.11	1.137

* Measured in person years.

Table A9 shows that exports require relatively less low-wage labor (weekly earnings under $300) than imports, similar shares of medium-wage labor ($300 to $599), and more high-wage labor (greater than $599). A significant share of the low-wage jobs generated by exports are in the agricultural sector, and the relatively greater share of high-wage jobs corresponds to the more intensive use of professional and managerial labor. Low-wage labor for the production of imports includes operatives and laborers in low-wage light manufacturing sectors, clerical workers in service sectors, and, to a lesser extent, farm workers. The high-wage labor requirements are explained by the relative importance of the petroleum and transportation equipment sectors.

TABLE A9
Shares of Employment Required for the Production
of Merchandise Exports and Imports by Wage Group
in 1987

Weekly Earnings	Exports	Imports	Total Economy
1. Under $199	10.7%	11.9%	12.0%
2. $200 - $299	21.7	22.7	22.3
3. $300 - $399	18.6	18.5	18.6
4. $400 - $499	15.6	15.1	15.4
5. $500 - $599	11.2	10.8	11.1
6. $600 - $749	9.6	9.2	9.5
7. $759 - $998	7.5	6.6	6.4
8. Over $999	5.6	5.2	4.7
Total	100.0	100.0	100.0

Table A9 shows that exports also systematically generate relatively fewer low-wage and more high-wage jobs than the economy as a whole where service sectors, generally paying low wages, are more important. Imports generate an employment distribution by wage group more similar to the distribution for the economy as a whole than exports, although also characterized by slightly more high-wage and slightly fewer medium-wage jobs.

Appendix B. Methodology and Classifications

Methodology

This appendix is divided into four sections the input-output model, the data sources, and the classification schemes for sectors and for occupations.

The Model

The basic input-output model using the notation of the Institute for Economic Analysis (IEA) is given in the following equations

$$x = Ax + Rx + y$$

$$e = Lx$$

where

x is a vector of total domestically produced output necessary to produce the final demand vector of exports or imports

y is a vector of exports or of imports

e is total labor requirements to produce the vector of output associated with exports or imports

A is a matrix of the domestically produced intermediate input requirements

R is a matrix of the domestically produced capital replacement requirements

L is a matrix of occupation by industry labor requirements

This model, unlike most other versions of the open static input-output model, includes the requirements for replacement of capital as explicit inputs; the construction of the R matrix is described in Leontief and Duchin (1986).

Some inputs used in production are produced domestically and others are imported. When the model described above is applied to compute output requirements for the entire bill of final deliveries (i.e., x = (I-A)-1y where y is the entire bill of final deliveries), x will correctly correspond to domestically produced goods and services only. However, when y includes less than the entire bill of final deliveries--the present case--the computations will no longer automatically net out the imported inputs. In order to assure the computation of domestically produced inputs, it was necessary to adjust the A and R matrices by reducing each coefficient so as to include only the domestic input requirements per unit of output. The full information necessary to divide the A matrix into its domestic and imported portions has not been collected in the US. Lacking this we assumed that every industry and final user absorbs identical proportions of imported to domestically produced items in each sector. Naturally, the proportions vary across sectors.

To make this adjustment, we relied upon each sector's output in 1986 because the total value of shipments by industry in 1987 are not yet available. The import shares of total shipments in 1986 were adjusted to reflect the detailed composition of 1987 imports. Service imports were divided among the service sectors in the same proportions as all service imports according to (Leontief, Duchin, et. al., 1985). Because the proportion of merchandise imports to total industry shipments was higher in 1987 than in 1986 actual use of imported inputs in 1987 will be somewhat underestimated by this method of estimation. Most studies of the effects on employment of trade have used a similar method to estimate

the domestic portion of production (Office of Technology Assessment, 1988; Rousslang and Parks, 1986; Stone and Sawhill, 1986; Young, Lawson, and Duncan, 1986).

Practically speaking, an import substitution scenario makes sense only when the import bill of goods is limited to competitive imports. While this distinction is always explicit in input-output tables, the official 1987 table will not be available for several years and we were obliged to use the entire import bill of goods which includes items like coffee and tea which cannot be reasonably produced in the US. Because of the large size and the diversity of the US economy, the dollar value of true non-competitive imports is small, amounting to only $13 billion out of total imports of $183 billion in 1977, the most recent year for which this data is available.

Another problem is the appropriate unit price of imports in the case where an item is imported precisely because its price is lower than that of the domestically produced counterpart. If the imported item is valued at the actual price (in a simple input-output model that does not distinguish prices and quantities), which is the case in this study, the total outlay for imports will be accurate but the labor required for import substitution will be slightly understated. If the imported item were priced at the domestic unit price, the labor required for import substitution would be accurate but the dollar outlay for imports is overstated. In a world model, briefly mentioned in the text, this problem would not arise because both prices and quantities could adjust for the import substitution scenario.

Data

The model described above requires extensive data describing production, capital replacement, employment, wages and the regional distribution of production. The data for intermediate inputs, replacement capital requirements, and labor requirements were based on

the 89 sector input-output model of the US economy model developed at the Institute for Economic Analysis (IEA) and described in Leontief and Duchin (1986). Deflators to convert the IEA database from the base year prices of 1979 to 1987 prices came from the Bureau of Labor Statistics (BLS) Time Series on Input-Output Industries (1988) and unpublished data.

The deflator for the sector producing computing equipment has always been problematic. In the past, BLS has systematically underestimated the fall in this sector's price. Current BLS deflators, which reflect an average annual price decline of 16 percent between 1979 and 1986, in our opinion now overstate the price decline. This study, relying on previous work by IEA, revised the annual average price decrease to 10 percent.

The Department of Commerce, in the official merchandise trade flows for 1987, also treated the sector producing computing equipment arbitrarily. In recent years imports of computing equipment have accounted for 93% or more of the value of total imports within the broader category, Computing and Office Machines and Equipment. For 1987 zero imports of computing equipment were reported; most imports of the broadly defined commodity were attributed to the sector producing office machines. This is clearly inappropriate. We redistributed these imports among the component sectors in the same proportions in as earlier years. Computers are one of the more labor-intensive manufacturing sectors, and the results reported in this study were very sensitive to the assumptions about the price deflator and the level of imports for this sector.

Employment by region was calculated using estimates of the proportion of total sectoral output produced within each of the four major regions--Northeast, South, Midwest, and West. These proportions were derived from a Department of Commerce (1988) report

on the shares of Gross State Product by 2-digit SIC industry for the most recent year available, 1986. It was implicitly assumes that if a region produced a certain percentage of a given sector's output, it produces the same share of the output necessary for exports or import substitution in that sector.

Two approaches were considered to distinguish employment by wage group: a tabulation by sector of the share of jobs with earnings by wage range without distinguishing occupations or the tabulation of mean earnings by occupation and industry. Both data sets had their shortcomings with respect to the level of detail of coverage. Computations were made with both and, it turned out, they produced similar results. The results based on the first method are reported in the text and the wage distribution for the production of imports and exports is compared with the wage distribution for the whole economy in 1987.

The matrix of wages by detailed industry and by eight wage groups was obtained from the Bureau of Labor Statistics (1988) based on the Current Population Survey for 1987. Because the industry classification used did not correspond exactly to the classification scheme used for our analysis, the matrix was aggregated to thirty-three sectors for calculations. The wages of part-time workers and estimates of fringe benefits were not included: wages correspond to salary for a full-time job. Eight groupings of 1987 weekly earnings are used in this study ranging from "less than $199" to "over $999."

TABLE B1
Sectoral Classification

Sector	Code and Title	BEA code
1	Agricultural Products	
	Livestock and livestock products	1
	Other agricultural products	2
	Forestry and fishery products	3
2	Raw Materials	
	Iron and ferroalloy ores mining	5
	Nonferrous metal ores mining	6
	Coal mining	7
	Crude petroleum and natural gas	8
	Stone and clay mining and quarrying	9
	Chemical and fertilizer mineral mining	10
3	Construction	11
4	Light Manufacturing I	
	Broad and Narrow Fabrics, Yarn and Thread Mills	16
	Miscellaneous textile goods and floor coverings	17
	Apparel	18
	Miscellaneous fabricated textile products	19
	Lumber and wood products, except containers	20
	Wood containers	21
	Household furniture	22
	Other furniture and fixtures	23
	Rubber and miscellaneous plastic products	32
	Leather tanning and finishing	33
	Footwear and other leather products	34
5	Light Manufacturing II	
	Food and kindred products	14
	Tobacco manufactures	15
	Paper and allied products, except containers	24
	Paperboard containers and boxes	25
	Printing and publishing	26
	Glass and glass products	35
	Stone and clay products	36
6	Chemical and Related Products	
	Chemicals and selected chemical products	27
	Plastics and synthetic materials	28

	Drugs, cleaning and toilet preparations	29
	Paints and allied products	30
	Petroleum refining and allied industries	31
7	Machinery and Other Heavy Manufacturing	
	Ordnance and accessories	13
	Primary iron and steel manufacturing	37
	Primary nonferrous metals manufacturing	38
	Metal containers	39
	Heating, plumbing and structural metal products	40
	Screw machine products and stampings	41
	Other fabricated metal products	42
	Engines and turbines	43
	Farm and garden machinery	44
	Construction and mining machinery	45
	Materials handling machinery and equipment	46
	Metalworking machinery and equipment	47
	Special industry machinery and equipment	48
	General industrial machinery and equipment	49
	Miscellaneous machinery, except electrical	50
	Service industry machines	52
	Electric industrial equipment and apparatus	53
	Household appliances	54
	Electric lighting and wiring equipment	55
	Miscellaneous electrical machinery and supplies	56
	Scientific and controlling instruments	62
	Optical, ophthalmic, and photographic equipment	63
	Miscellaneous manufacturing	64
8	Electronics and Telecommunications Products	
	Electronic computing and related equipment	pt. 51
	Office equipment, except electronic computers	pt. 51
	Radio, TV, and communications equipment	pt. 56
	Electron tubes	pt. 57
	Semiconductors and related devices	pt. 57
	Electronic components, n.e.c.	pt. 57
9	Transportation Equipment	
	Motor vehicles, parts and equipment	59
	Aircraft and parts	60
	Other transportation equipment	61
10	Business Services	
	Agricultural, Forestry, and fishery services	4
	Transportation and warehousing	65
	Communications, except radio and TV	66

	Radio and TV broadcasting	67
	Electric, gas, water and sanitary services	68
	Wholesale trade	pt. 69
	Retail trade	pt. 69
	Finance	pt. 70
	Insurance	pt. 70
	Real Estate and rental	71
	Business services	73
11	Non-business Services	
	Hotels, personal and repair services	72
	Eating and drinking places	74
	Auto repair services	75
	Amusements	76
	Hospitals	pt. 77
	Health services, excluding hospitals	pt. 77
	Educational services	pt. 77
	Nonprofit organizations	pt. 77
	Government enterprises	78, 79

TABLE B2
Occupational Classification

Occupational Code and Title

Professional and Technical Workers
- Electrical engineers
- Industrial engineers
- Mechanical engineers
- Other engineers
- Natural scientists
- Computer programmers
- Computer systems analysts
- Other computer specialists
- Personnel and labor relations specialists
- Physicians and surgeons
- Registered nurses
- Other medical professionals
- Health technologists and technicians
- Teachers
- Drafters
- Other professional and technical workers

2 Managerial Workers

3 Sales Workers

4 Clerical Workers
- Stenographers, typists, and secretaries
- Office machine operators
- Bank tellers
- Telephone operators
- Cashiers
- Other clerical

5 Precision and Crafts Workers
- Carpenters
- Electricians
- Plumbers and pipefitters
- Other construction craft workers
- Foremen, n.e.c.
- Machinists
- Tool and die makers
- Other metal working craft workers
- Mechanics and repairers
- Printing trade craft workers

Transportation, public utilities crafts, and other craft workers
Crane, derrick, and hoist operators
Other craft workers

6 Operatives
Assemblers
Checkers, examiners, inspectors
Packers and wrappers
Painters
Welders and flame cutters
Delivery and route workers
Truck drivers
Other operatives
Robot technicians

7 Service Workers
Janitors and sextons
Protective service workers
Food service workers
Other service workers

8 Laborers

9 Farmers and Farm Workers
10 Total Workers